"Growing Montana"

Montana Agricultural Business Association

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SENATE AGRICULTURE
EXHIBIT NO. 2
DATE 2·12·2009
BILL NO. SB300

SENATE COMMITTEE ON AGRICULTURE, LIVESTOCK & IRRIGATION
February 12, 2009 Hearing on Senate Bill 300
Testimony of Montana Agricultural Business Association

Mr. Vice Chairman, members of the committee, for the record my name is Jeff Farkell and I work for Centrol, a crop consulting firm in Brady serving growers in North Central Montana. I am testifying today as a Certified Crop Adviser, a member of the Fertilizer Advisory Committee and for the Montana Agricultural Business Association in support Senate Bill 300 which provides an overdue increase in the fertilizer/crop nutrient check off to support more research.

The association's board of directors voted to support this legislation on January 30, 2009 after providing the membership with the opportunity for input during our annual convention in Great Falls. We need science-based research information as we provide advice to growers using fertilizer.

<u>This is a change in position for the Montana Agricultural Business Association</u> whose members include fertilizer applicators, retailers, distributors and manufacturers as well as crop consultants. <u>MABA opposed any increase in February 1992</u>, when we outlined why in a letter to the industry members of the fertilizer advisory committee. Our concerns as expressed in that letter were:

1. ". . .we have yet to see a good program implemented to get the research information out to the dealers and growers. It is difficult to support an increase when few know what's happening with the current ton tax funds" and,
2. ". . .there are some concerns about the practical applicability of some research projects being done."

That year, Fertilizer Advisory Committee recommended to MSU that the first change MABA suggested be made. Dr. Jeff Jacobsen developed "Fertilizer Facts" and since September 1992, these have been published by Montana State University College of Agriculture and the Extension Service to provide the research results to retailers and growers. The latest were published last month and we are providing you with Number 53 in the series. Funding requests to enable research projects for someone to get tenure are rejected by the committee in favor of research that helps the Montana grower. If you look at the list of research projects, you will see the projects that have been funded and their applicability.

We think the Fertilizer Advisory Committee is functioning well to assure research meets the needs of Montana growers and urge you to allow the increase. It requires no general fund money.

MABA's intent is to support fertilizer research funding in this legislation. Any amendments to alter any part of the increase to support education or regulation would force the association's board to rethink its support.

We ask you to support Senate Bill 300. Thank you for the opportunity to testify before your committee and we welcome questions. If we can't answer them today, we will provide the information before you take executive action on this bill. Thank you. Mr. Vice Chairman.

A Tool to Determine Economically Optimum Nitrogen Rates for Small Grains

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Fertilizer FACTS

Fertilizer Check off

January 2009

Number 53

MONTANA STATE UNIVERSITY

Extension Service
Agricultural Experiment Station

Introduction

Fluctuating and sometimes high nitrogen (N) fertilizer costs and small grain prices have made it very difficult to determine the economically optimum N rate (EONR). MSU fertilizer guidelines (EB 161) and most crop adviser recommendations are based on a constant lb N per bu (lb N/bu), yet this approach does not take into account fertilizer costs, grain prices, or organic matter (O.M.) content and thus likely does not optimize economic return. Therefore, there is a need for the development of economic models in Montana to determine the EONR for small grains.

Methods

Nitrogen yield response curve data for spring wheat, winter wheat, and barley were compiled from Agricultural Research Center annual reports and personnel. These data were for both on- and off-station plot studies. There were a total of 128 spring wheat (1993-2006), 350 winter wheat (1970-2006), and 491 barley data points (1981-2006), with a majority of the data collected in the Golden Triangle. The vast majority of the studies were conducted on fallow dryland sites; data from both irrigated fields and recrop situations were excluded from further analysis due to small sample size.

The barley data was largely from a study evaluating seeding rate, applied N, and applied sulfur (S). Because S is rarely added to barley fields, and S can increase grain protein, only data from the 0 S treatment were included. The final data sets consisted of at least 96 data points for each crop.

Yield models were developed that included maximum yield (or yield potential) for each trial, total available N, and O.M.. All models shown here use standard English units (e.g. bu/ac, lb N/ac).

The best fitting yield model equation was a "quadratic-plateau" model. This has the form:

Yield = $a*TUN - (a^2/(4*YP))*TUN^2$ when TUN<YMN

Yield = YP when TUN $\geq$ YMN

Where TUN = total useable N (soil N to 3 ft. + fertilizer N + c*O.M.), c is a constant, YP is yield potential, and YMN (yield maximizing N) is the TUN where peak yield is achieved.

An optimizing routine was used to find the best fitting coefficients for these equations for each crop. Models were also developed for protein and plump, yet in the interest of space are not shown here.

Net marginal return was calculated as the difference between grain revenue and N fertilizer cost. For wheat, grain revenue included protein discounts or premiums and for barley it was assumed that if plump was too low (<75 - 80%) or protein too high (>13.0 - 13.5%), that revenue would be based on the feed barley rather than the malt barley price.

Results

The values of "a" in the yield model were determined to be 0.55, 0.58, and 1.34 for spring wheat, winter wheat, and barley, respectively. A higher number means that it takes less N to grow a bushel of that crop, in agreement with what is known about N responses between wheat and barley. The values of "c" were found to be 27.4, 14.8, and 8.5 for spring wheat, winter wheat, and barley respectively, suggesting that O.M. is more important for increasing spring wheat yield, than for increasing either winter wheat or barley yield. The r^2-values for the three yield models were 0.92, 0.92, and 0.89, respectively.

Net marginal returns and EONR are highly affected by spring wheat grain price and N fertilizer cost (Figure 1). For example, if wheat is \$9/bu, the protein discount is 16¢/0.25% protein, urea costs \$450/ton, and the yield potential is 50 bu/ac, the model predicts an EONR of approximately 170 lb available N/ac or 3.4 lb N/bu. However, at \$5/bu wheat and \$850/ton urea, the model predicts an EONR of 125 lb N/ac or 2.5 lb N/bu. These values will change if O.M., protein discount, or yield potential changes. For example, at \$7/bu spring wheat and \$550/ton urea, the EONRs are 120 and 210 lb available N/ac for a 50 bu/ac yield potential at protein discounts of 8¢ and 24¢/0.25%, respectively (Figure 2).

The models are online at: http://www.montana.edu/softwaredownloads/cropdownloads.html. Figure 3 shows a screen shot of the net revenue estimate for the spring wheat online model. The input values can be easily changed by moving a "slider", causing the net revenue graph to change instantaneously.

Fertilizer Facts:

- The economically optimum N rate (EONR) can be determined using the economic model.
- The EONR can be substantially different depending on fertilizer price, grain price, and protein discount.
- Models for spring wheat, winter wheat, and barley are online, and are also "slider" driven, making them user-friendly.

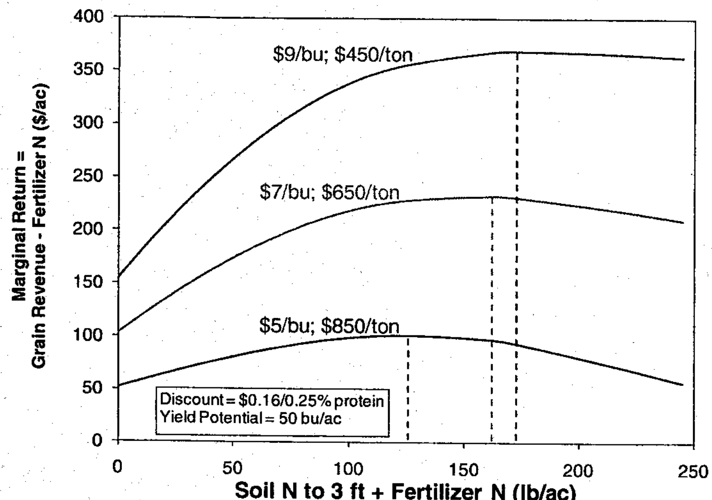

Figure 1. Effect of available N and price:cost ratios on marginal return assuming O.M. = 2%, a protein discount of 16¢/0.25% and a yield potential of 50 bu/ac. Dashed lines show EONRs.

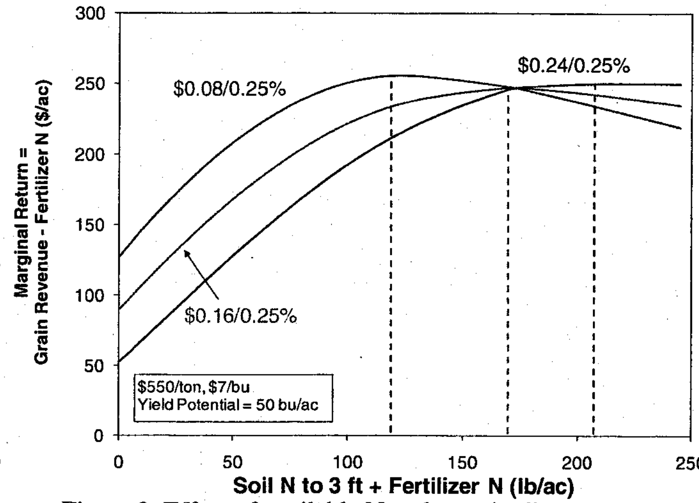

Figure 2. Effect of available N and protein discount on marginal return assuming O.M. = 2%, \$550/ton urea, \$7/bu wheat, and a yield potential of 50 bu/ac. Dashed lines show EONRs.

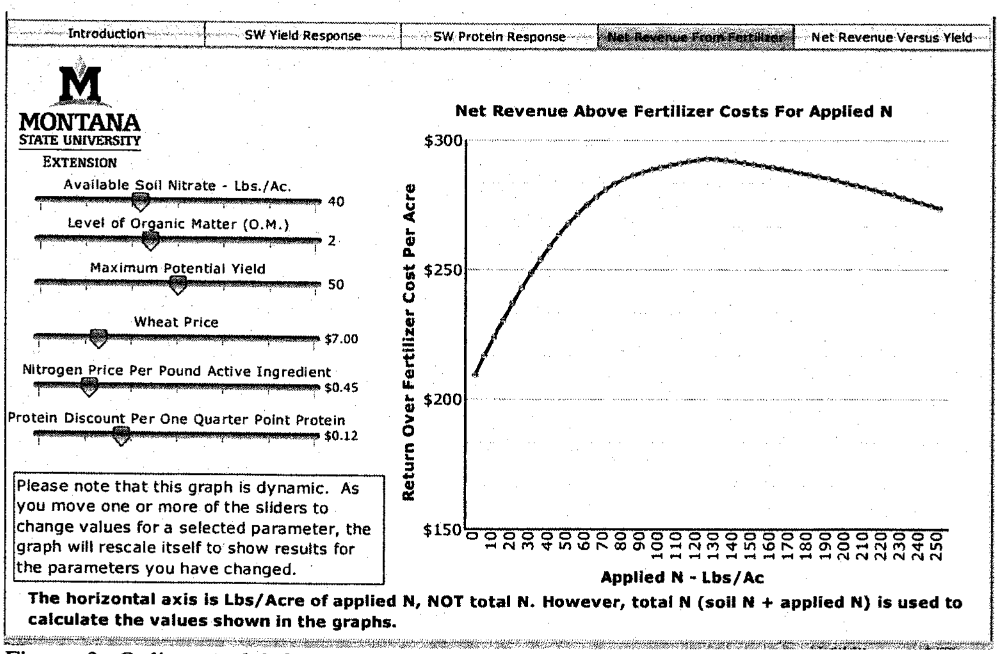

Figure 3. Online model for spring wheat showing the Net Revenue graph indicating the economically optimum level of fertilizer application.

Edited by Clain Jones, Extension Soil Fertility Specialist, and Elizabeth D'Imperio, Research Associate

The programs of the MSU Extension Service are available to all people regardless of race, creed, color, sex, disability or national origin. Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Douglas Steele, Vice Provost and Director, Extension Service, Montana State University, Bozeman, MT 59717.

Potential Fertilizer Research and Education Programs

- ✓ Break-out of CRP and nutrient management practices.
- ✓ Correlation of micronutrient response to Montana crops.
- ✓ Developing calibration techniques to map wheat nitrogen status using digital aerial photographs.
- ✓ Development of on-the-go grain protein sensing technology to develop nutrient management zones for precision nitrogen fertilization.
- ✓ Effect of phosphorus fertilization on yield under dry conditions.
- ✓ Enhanced efficiency fertilizers.
- ✓ Evaluate fertilizer use on seeded dryland perennial forages to improve production efficiency.
- ✓ Evaluations of rapid in-field diagnostic tools for nutrient management.
- ✓ Evaluations of new fertilizer and soil amendment materials.
- ✓ Farm-scale knowledge of fertilizer N offset opportunities via biological N fixation by legume crops – soil, climatic and management considerations.
- ✓ Fertility management for barley forage.
- ✓ Fertilizer impacts on soil quality and health.
- ✓ Fertilizer interactions with pest management practices.
- ✓ Fertilizer N losses as ammonia volatilization following broadcast applications of N fertilizer.
- ✓ Fertilizer supplements to reduce wheat stem sawfly losses.
- ✓ Greenhouse gas emissions associated with application of nitrogen to Montana's dryland and irrigated crops.
- ✓ Heavy metals, fertilizers, and plant uptake.
- ✓ Improved laboratory analytical methods for Montana crops and soils.
- ✓ Integration of fertilizer and irrigation strategies to offset water restrictions due to threatened trout recovery projects.
- ✓ Integration of soil and plant analysis into nutrient management practices.

- ✓ Long-term impacts of fertilizer on soil biological, chemical and physical properties.
- ✓ Nutrient-disease interactions.
- ✓ Nutrient-insect interactions.
- ✓ Nutrient management impacts on soil C and N storage.
- ✓ Nutrient management practices for grass seed production.
- ✓ Nutrient recommendations following alternate crops.
- ✓ Nutrient stratification and availability in no-till cropping system.
- ✓ Organic matter mineralization impacts on nitrogen recommendations.
- ✓ Over-winter nitrogen mineralization study (A comparison of late summer and early fall sampling strategies).
- ✓ Placement, timing, and rate for optimum nutrient management.
- ✓ Plant availability of micronutrient materials.
- ✓ Precision farming with fertilizer inputs.
- ✓ Precision nutrient management (Evaluation of worth of zone fertilization compared to uniform fertilization)
- ✓ Predicting canola spring wheat responses to sulfur fertilization.
- ✓ Reduced and no-till impacts on nutrient management.
- ✓ Routine fertility response to new crops, e.g., pulse, oilseed.
- ✓ Safflower response to sulfur fertilization.
- ✓ Soil test laboratory comparisons.
- ✓ Varietal response and crop quality impacts from applied nutrients.
- ✓ Verifying fertilizer economic models.
- ✓ Yield, protein, and growth responses to N and water in four winter wheat cultivars.

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HISTORICAL FERTILIZER ASSESSMENT FUNDING

YEAR	P.I.	PROJECT	AMOUNT FUNDED
2008	Chen, Jones, Miller, Westcott, Wichman	Nitrogen fertilizer use efficiency and recommendations for tilled and no-till soils under different cropping systems	$ 12,918
	Eckhoff	Durum management to reduce cadmium uptake	$ 10,000
	Engel, Whitmus	Fertilizer induced losses of nitrous oxide gas from Montana dryland cropping systems	$ 18,000
	Jackson, Whitmus, Carlson, Westcott	Improving nitrogen use efficiency in spring wheat using sensing technology and split nitrogen applications	$ 18,085
	Jones, Chen, Eckhoff, Jackson, Lamb, McVay, Stougaard, Westcott, Larson	Magnitude of nitrogen mineralization between fall and spring sampling: Effects of previous crop, weather, and soil properties	$ 15,400
	Miller, Burgess, Engel, Jones, Flikkema	Improving energy-efficiency of nitrogen fertilizer use through biological N replacement strategies	$ 19,833
	Westcott, Kephart	Nitrogen fertilization for corn for grain	$ 16,500
2007	Chen, Jones	Nitrogen fertilizer use efficiency and recommendations for tilled and no-till soils under different cropping systems	$ 16,902
	Eckhoff	Durum management to reduce cadmium uptake	$ 9,000
	Engel, Sainju	Fertilizer induced losses of nitrous oxide gas from Montana dryland cropping systems	$ 16,500
	Jackson, Whitmus, Carlson, Westcott	Improving nitrogen use efficiency in spring wheat using sensing technology and split nitrogen applications	$ 17,085
	Jones, Chen, Engel, Jackson, Lamb, Miller, Westcott, Larson	Magnitude of nitrogen mineralization between fall and spring sampling: Effects of previous crop, weather, and soil properties	$ 11,400
	Jones, Chen	Tillage effects on phosphorus availability	$ 3,300
	Miller, Engel, Flikkema	Improving energy-efficiency of nitrogen fertilizer use through biological N replacement strategies	$ 13,920
	Westcott, Kephart	Nitrogen benefits in soybean-small grain rotations	$ 6,000
2006	Bergman	Safflower response to foliar applied nitrogen fertilization in the rosette growth stage under recrop conditions	$ 1,500
	Chen, Jones	Nitrogen fertilizer use efficiency and recommendations for tilled and no-till soils under different cropping systems	$ 17,912
	Eckhoff	Fine-tuning a nitrogen budget system for sprinkler and flood irrigated sugar beet production	$ 7,500
	Engel, Sainju	Fertilizer induced losses of nitrous oxide gas from Montana dryland cropping systems	$ 16,500
	Griffith, Jones, Jackson, Stauber	Proposal to develop an economic optimal analysis system for fertilizer application rates for common Montana crops	$ 19,500
	Jackson, Chen, Johnson, Westcott	Camelina nutrient management	$ 15,000
	Jones, Chen	Tillage effects on phosphorus availability	$ 7,400

YEAR	P.I.	PROJECT	AMOUNT FUNDED
2008	Westcott	Nitrogen benefits in soybean-small grain rotations	$ 13,900
	Whitmus, Carlson, Westcott	Improving nitrogen use efficiency in dryland wheat using new sensing technology and split applications of nitrogen	$ 5,000
2005	Bergman	Safflower response to foliar applied nitrogen fertilization in the rosette growth stage	$ 1,500
	Chen, Jones	Nitrogen fertilizer use efficiency and recommendations for tilled and no-till soils under different cropping systems	$ 17,910
	Eckhoff	Fine-tuning a nitrogen budget system for sprinkler and flood irrigated sugarbeet production	$ 7,500
	Engel, Miller, Brown, Inskeep, Jones	Improved carbon and nitrogen analytical facilities to support research in fertilizer management and nutrient cycling	$ 15,000
	Jones	Determining the accuracy of test strips, home test kits, and colorimeters for instantaneous measurement of soil nitrate levels	$ 5,500
	Miller, Wichman, Engel	Maximizing the value of annual legume forage through N cycling in direct-seeded crop sequences with wheat	$ 22,480
	Weaver	Do varying rates of nitrogen and sulfur fertilization on winter wheat influence production of volatile attractants for wheat stem fly?	$ 12,000
	Westcott	A nitrate stability index for cereal forages	$ 4,500
	Westcott	Sulfur fertilization of soybeans	$ 3,500
	Westcott	Nitrogen benefits in soybean-small grains rotations	$ 3,500
2004	Bergman	Safflower response to foliar applied nitrogen fertilization in the rosette growth stage	$ 1,500
	Chen	Nitrogen management in wheat - promoting main stems or tillers?	$ 9,400
	Chen, Jackson	Phosphorous fertilizer for pea, lentil, and chickpea	$ 15,000
	Eckhoff	Fine-tuning a nitrogen budget system for sprinkler and flood irrigated sugar beet production	$ 7,500
	Engel, Long, Jackson	Origin and plant availability of ammonium-nitrogen in Montana soils	$ 10,200
	Jones	Determining the effects of diversified no-till cropping systems on soil nutrient status	$ 7,000
	Miller, Wichman, Engel	Maximizing the value of annual legume forage in direct-seeded crop sequences with wheat	$ 21,821
	Weaver	Do varying rates of nitrogen and sulfur fertilization on winter wheat influence production of volatile attractants for wheat stem sawfly?	$ 12,000
	Westcott, D, Johnson, Neill	Fertility management for barley forage	$ 7,000
2003	Bergman	Safflower response to sulfur fertilization	$ 1,500
	Chen	Nitrogen management in wheat - promoting main stems or tillers?	$ 9,400
	Chen, Jackson	Phosphorous Fertilizer for pea, lentil, and chickpea	$ 15,000
	Eckhoff	Fine-tuning a nitrogen budget system for sprinkler and flood irrigated sugar beet production	$ 7,500
	Engel	Yield, protein, and growth responses to N and water in four winter wheat cultivars	$ 5,000

YEAR	P.I.	PROJECT	AMOUNT FUNDED
2008	Engel, Long, Jackson	Origin and plant availability of ammonium-nitrogen in Montana soils	$ 10,100
	Jones	Effect of humic acid on phosphorus availability and spring wheat yield	$ 5,800
	Miller, Wichman, Engel	Maximizing the value of annual legume forage in direct-seeded crop sequences with wheat	$ 20,116
	Westcott, D, Johnson, Neill	Fertility management for barley forage	$ 7,000
2002	Bergman	Safflower response to sulfur fertilization	$ 1,500
	Eckhoff	Durum response to top-dressed nitrogen and sulfur	$ 7,500
	Engel, Carlson, Long	Yield, protein, and growth responses to N and water in four winter wheat cultivars	$ 19,400
	Jones	Effect of phosphorus fertilization on yield under dry conditions	$ 6,000
	Miller, Wichman, Cash, Engel	Maximizing the value of annual legume forage in direct-seeded crop sequences with wheat	$ 19,076
	Westcott, D, Johnson, Neill	Fertility management for barley forage	$ 16,000
2001	Cash, Ansotegui	Sulfur recommendations for irrigated alfalfa	$ 8,544
	Eckhoff	Irrigated durum response to top-dressed nitrogen and sulfur	$ 7,500
	Engel, Carlson, Long	Yield, protein, and growth responses to N and water in four winter wheat cultivars	$ 21,600
	Jones	Effects of phosphorus fertilizer coatings on dissolution rates and plant nutrient uptake	$ 8,850
	Miller, Engel, Cash, Holmes	Optimizing fertilizer N in direct-seeded, diversified crop sequences	$ 12,300
	Westcott	HRS wheat grain protein–Interactions of nitrogen and water availability in uptake and distribution of late-season N	$ 2,000
	Wichman	Evaluating fertilizer use on seeded dryland perennial forages to improve production efficiency	$ 4,750
2000	Eckhoff	Irrigated durum response to nitrogen	$ 7,500
	Engel, Carlson, Long	Yield, protein, and growth responses to N and water in four winter wheat cultivars	$ 21,600
	Jackson, Miller, Engel, Welty	Predicting canola and spring wheat response to sulfur fertilization	$ 25,000
	Miller, Engel, Cash	Optimizing fertilizer N in direct-seeded, diversified crop sequences	$ 21,400
	Westcott, Long	Developing calibration techniques to map wheat nitrogen status using digital aerial photographs	$ 15,000
1999	Eckhoff	Irrigated durum response to nitrogen	$ 7,500
	Engel	Yield and protein responses to N and water in four winter wheat cultivars	$ 4,950
	Engel	Understanding differences in wheat varietal response to Cl fertilization	$ 5,500
	Inskeep	Analytical facilities to support research and outreach in nitrogen fertilizer management	$ 12,000
	Jackson	Barley and winter wheat nutrient management	$ 3,000
	Miller	Optimizing fertilizer N in direct-seeded, diversified crop sequences	$ 16,800
	Westcott	Use of remote sensing for correcting late-season nitrogen deficiencies in wheat	$ 23,000
1998	Eckhoff	Irrigated durum response to nitrogen	$ 7,500
	Engel	Yield and protein responses to N and water in four spring wheat cultivars	$ 21,640
	Jackson	Barley and winter wheat nutrient management	$ 6,000

1998

YEAR	P.I.	PROJECT	AMOUNT FUNDED
2008	Jackson	Specialty crop nutrient management	$ 5,000
	Jacobsen	Trace element accumulation and bioavailability in Montana soils	$ 6,400
	Westcott	Use of remote sensing for correcting late-season nitrogen deficiencies in wheat	$ 20,000
	Wichman	Response of established dryland perennial forages to N, P, K and S applications	$ 3,000
1997	Engel/Long	Yield and protein responses to N and water in four spring wheat cultivars	$ 23,568
	Jackson	Barley and winter wheat nutrient management	$ 6,000
	Jackson	Specialty crop nutrient management	$ 12,000
	McDermott	Phosphate fertilizer placement and effects on legume growth	$ 6,000
	Westcott	Timing, rate, and source of N topdressing for protein enhancement in wheat	$ 28,872
	Wichman	Response of established dryland perennial forages to nitrogen, phosphorus, potassium, and sulfur applications	$ 3,000
1996	Eckhoff	Nutrient management of irrigated dry beans	$ 7,000
	Engel	Yield and protein responses to N and water in four spring wheat cultivars	$ 21,000
	Jackson	Spring barley and winter wheat nutrient management	$ 11,000
	Westcott	Managing nitrate levels in cereal forages	$ 4,500
	Westcott	Timing, rate, and source of N topdressing for protein enhancement in wheat	$ 28,872
	Wichman	Response of established dryland perennial forages to nitrogen, phosphorus, potassium, and sulfur applications	$ 3,000
1995	Eckhoff	Nitrogen x harvest date interactions in sugar beets: Evaluation of nitrates in soil and groundwater	$ 9,500
	Jackson	Spring wheat fertility	$ 8,000
	Long	Site-specific nutrient management for dryland wheat production: Profitability of variable nitrogen fertilization	$ 19,400
	Skogley	Soil test variability and the impact of different fertilizer recommendations on the Montana crop producer	$ 7,000
	Westcott	Plant diagnosis for protein management in spring wheat	$ 29,520
	Wichman	Response of established dryland perennial forages to N, P, K, and S.	$ 3,000
	Wraith	Real-time measurement of root zone water and fertilizer status for improved decision making	$ 8,000
1994	Eckhoff	Nitrogen x harvest date interaction in sugar beets: Evaluation of nitrates in soil and groundwater	$ 9,500
	Inskeep	Contribution of nitrogen mineralization to groundwater nitrate contamination associated with crop-fallow practices	$ 10,440
	Jackson	Spring wheat fertility	$ 8,000
	Long	Profitability of site-specific nitrogen application	$ 12,000
	Westcott	Nitrogen and irrigation management for peppermint	$ 10,000
	Westcott	Plant diagnosis for protein management in spring wheat	$ 30,000

YEAR	P.I.	PROJECT	AMOUNT FUNDED
1993	Eckhoff	Nitrogen management of sugar beets at four harvest dates	$ 8,300
	Inskeep	Contribution of N mineralization to groundwater nitrate contamination associated with crop fallow rotations	$ 15,000
	Jackson	Spring wheat fertility	$ 16,650
	Westcott	Nitrogen and irrigation management for peppermint	$ 12,900
	Wichman	Response of established dryland perennial forages to N, P, K, and S applications	$ 3,800
1992	Engel	Effect of fertilizer N and available water on yield and quality of oat and safflower	$ 10,900
	Inskeep	Contribution of N mineralization to groundwater nitrate contamination associated with crop fallow rotations	$ 15,000
	Jacobsen	*Fertilizer Fact* sheets	$ 1,000
	Schaff	Soil fertility research	$ 15,936
	Westcott	Nitrogen and irrigation management for peppermint	$ 8,118
1991	Berg	Fertilizer efficiency for dryland small grain production	$ 7,000
	Engel	Effect of fertilizer N and available water on yield and quality of safflower and oat varieties	$ 7,000
	Inskeep	Solute transport modeling for predicting movement of ag chemicals in soils	$ 15,000
	Skogley	Development and verification of improved soil and environmental tests	$ 22,000
	Westcott	Nitrogen fertilizer management for potatoes	$ 9,000